SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

No. 1790.—Vol. XXXIX. LONDON, SATURDAY, DECEMBER 11, 1869. {STAMPED .. SIXPENCE. UNSTAMPED. FIVEPENCE.

Original Correspondence.

COAL-BREAKING MACHINERY.

PREVENTION OF COLLIERY EXPLOSIONS—GUNPOWDER AND BLASTING SUPERSEDED.

SIR,—Without the least desire to interfere with the controversy now pending between Mr. J. Grafton Jones and Messrs. Jones and Bidder in your columns, it might, perhaps, interest some of your readers to know that neither one nor the other of the said claimants can, with any show of justice, put themselves forward as the *original* or *true authors* of the invention.

Mr. J. Grafton Jones obtained his patent in June, 1867.

Messrs. Jones and Bidder's patent is dated November, 1868; and mine is dated December, 1863.

The wording of my patent is as follows:—

"One of our improvements consists in using a ram worked by hydraulic power by pumping, for the purpose of splitting or detaching the coal, stone, or mineral from the mass, thus rendering the use of gunpowder or other explosive agent unnecessary. One of the modes of effecting this is by driving a wedge, or chisel, or other suitable cutting tool into the coal, stone, or mineral by the power of the ram or other apparatus, after the operation of boring or undermining has been effected. In some cases it may be found beneficial to employ more than one wedge, chisel, or tool. This plan will have the advantage of dispensing with the necessity of boring or drilling.

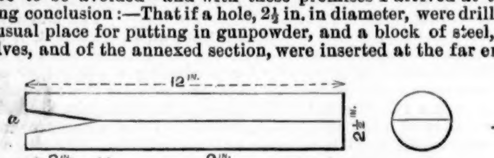
"Another method of effecting this is by boring a hole in the coal, stone, or mineral, into which one or more ram or rams or other apparatus can be introduced, and the coal, stone, or mineral is then detached by the expansion of the ram or rams or other apparatus."

I offer no comments upon the proceedings of any of the parties, beyond expressing the belief that they are all infringing upon my legal rights.—*Burley Wood, near Leeds.* W. FIRTH.

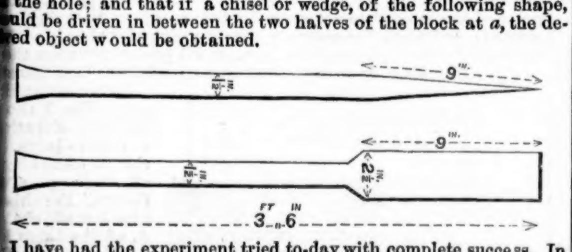
WEDGING OF COAL.

SIR,—I have just now put to the test of practice that which struck me as being correct in theory, and have found the result satisfactory. After coal has been holed under, and (in stall work) picked up, it is clear that the driving of a wedge into the front of that which requires to be broken off at the back is not the proper way to accomplish the object; but it is equally true that, even with this unscientific process, hand-power is, in most cases, sufficient to wedge down the coal by means of the mall: in many cases, indeed, the labour being very considerable. It, therefore, occurred to me that a far more effective system of wedging might be adopted, whereby the present labour might be reduced, and much more satisfactory results than at present obtained—and this by the use of very simple appliances.

It is to be borne in mind that when holed the coal is required to be rent down at the back from the solid coal which the holing has not undermined. If we use any of our power in driving a point into coal, as in the case of the ordinary wedge, much of our labour is very badly applied—as it is obvious that the driving forward of a point into coal is not an effectual way of forcing down a block, its tendency certainly not being that of making the necessary rent at the back. It is, in point of fact, the thick part of the wedge, where its section is greatest, driven forward that produces the necessary rent downwards—and this effect is more frequently produced at some point far short of where it ought to be, in proportion to the depth holed under. I, therefore, took as my basis that hand-power, properly applied, is sufficient; that the force must be applied at the back, and not at the front, of the coal; that points or wedges driven direct into the coal itself are to be avoided—and with these premises I arrived at the following conclusion:—That if a hole, 2½ in. in diameter, were drilled in the usual place for putting in gunpowder, and a block of steel, in two halves, and of the annexed section, were inserted at the far end



of the hole; and that if a chisel or wedge, of the following shape, could be driven in between the two halves of the block at *a*, the desired object would be obtained.



I have had the experiment tried to-day with complete success. In one place the coal was 3 ft. 1½ in. thick. The width of coal brought down was 19 ft., the holing under 3 ft., and the height of the holing in front 15 in. This was brought down in about 20 minutes, a little wedging by a single wedge being required towards the right-hand side. In the other the coal was 3 ft. 4 in. thick, the width of coal brought down 18 ft., the holing under 4 ft., and the height of the holing in front 15 in. This was brought down in three-quarters of an hour, a little wedging being also necessary at the right-hand side. Each of these auxiliary wedgings was rendered necessary from the direction of the place as compared with the cleavage of the coal. It is necessary to state that, in both cases, the direction of the places was cross-cut, and the fracture produced a cross-cut fracture. The coals, in both cases, came down the full width, and for the full depth of the holing.

I have every confidence that the above mode of bringing down coal will be found effectual in most cases. It has the advantage of being extremely simple, and requires tools no more unwieldly, cumbersome, or complicated than the coal miners' ordinary tools. Whatever the value of the idea may be, the public are heartily welcome to it.

Dec. 4. G.

P.S.—Since writing the above I have seen, in the Proceedings of the Institute of Civil Engineers, vol. 28, in a paper "On Machines Employed in Working and Breaking Down Coal, so as to Avoid the Use of Gunpowder," by Mr. Samuel P. Bidder, jun., that "Experiments have also lately been made by Mr. Farmer with a machine, consisting of a long wedge, formed like a spear, which, when driven between two guides with an 18-lb. hammer, required about 300 blows to bring it home, and even with that force failed to break down the coal." There is a strong resemblance between this and the plan above described. Not having any knowledge of the proportions of Mr. Farmer's apparatus, I should think it must differ considerably from that used above. The hammer used was a sinker's ordinary mall.

WELSH COAL FOR THE SOUTH OF ENGLAND.

SIR,—With reference to the proposed canal from Combwich to Langstone Point, at a cost of 3,500,000*l.*, to which reference is made in the Journal of Nov. 27, I would call the attention of the coal proprietors of South Wales to the fact than an opening for their coal, &c., to the South of England can be made for less than a hundredth part of the amount named. Thus, lines of rail already exist from Highbridge to Taunton, thence to Chard, and thence to Axminster. It is only necessary to form a quay at Highbridge, and continue a railway from Axminster to Lyme Regis, where there is a well-built harbour. This, with a line of steamers from Cardiff, would make the means of transit complete. The distance from Axminster to Lyme is only about five miles; the country presents no great engineering difficulties, and the line ought not to cost more than 15,000*l.* If the coal owners of Wales really wish to open a trade with the South Coast of England my proposed scheme is well worth their consideration.

Lyme, Dorset. F. H.

DENUDATIONS, AND PROPOSED VENTILATION OF MINES.

SIR,—In continuation of my letter which appeared in the Supplement to the Journal of the 23d, and treated of denudations, I now propose to give consideration to the "new mode of ventilating mines" suggested by Messrs. Windhausen, Forbes, and Born, by means of an air compressing machine, which produces a degree of cold sufficient to congeal mercury, and which they anticipate will "as soon as the machine is set to work, the cold atmosphere coming from the machine, being heavier than the air in the mine, force the impure air and all other gases out, thereby purifying the mine and making it wholesome and habitable, at the same time preventing explosions," as stated in the Supplement to the Journal of Sept. 18; but this fact being novel, to its comprehension reference must be made to others intimately connected with it, and these shall first receive attention.

If four of sulphuric acid be poured on one of ice there is generated a heat of 212°, but if the proportions be reversed, and one of acid be poured on four of ice, there is produced a cold of 4° below Zero, the cold of the freezing mixture of ice and salt; and, I strongly suspect, of the above referred to compressed air, and which, *if repeated or continued in its application*, will congeal mercury; and if the bulb of a thermometer be continuously moistened with ether the mercury likewise will be frozen, yet, *on the evidence of the thermometer*, we are told that the temperature of the Polar regions is sometimes 20° or 40° below Zero, a fallacy that has presented itself while writing, it being evident, on the above facts, the temperature of those regions may never be lower than that of 4° below Zero, the temperature of the freezing mixtures, which, again, is a temperature indicated by the thermometer, the mercury of which *gradually falls* to the indicated cold necessarily by gradually *absorbing* cold.

If electricity be induced, either by friction or by chemical action, it may be applied to the charging of a battery, or positively electrifying a body *by gradual accumulation*, and, if in the conducting wire there should be a break, the spark will fire combustible matter, indicating "heat," but if the wire be connected with a salt in solution crystallisation results, indicating cold, and this salt, during *rapid decrystallisation*, produces the cold of the freezing mixture, and which freezing mixture, if connected with a solution by a fine copper wire, will again reproduce the salt; and as the wire may be 10 or 100 ft. long, and cold, as commonly understood, such as that of ice, is not perceptible at the distance of a few inches, the cold must be something more than "cold." Here, then, is an intense cold produced, scientifically, from no apparent cause, and if to common salt chloride of sodium (which for convenience I shall designate by its old name, muriate of soda) sulphuric acid be added, the sulphuric acid will combine with the soda and expel the muriatic as a gas, without producing the slightest change of temperature; but if the latter acid be made to pass into water, during the operation a heat, or caloric, is produced of 212°. In the first fact free electricity is evolved, and produces a cold similar to that of intense frost, when the atmosphere becomes electrical in proportion to the cold, or, more properly, the cold increases as the air, from some cause, becomes surcharged with electricity, the supply being greater than the demand; and in the second much heat from contrary conditions, a great demand for the combining agent, whilst the supply is deficient; and although I have not made the experiment, if ice were substituted for the water there would necessarily be no heat so long as any ice remained undissolved; and as the combination of muriatic acid and water is unattended by the "evolution of heat" the temperature of 212° is evidently caused by the condensation of the gas into a fluid, and which heat certainly was not latent in the salt.

Let us now apply the above facts and principle to the steam-boiler, and I think we shall discover that there too the heat doctrine will be found no less wanting. In my letter which appeared in the Supplement to the Journal of Sept. 25, on the Abolition of the Patent Laws, I gave an extract from one of 1845 to the directors of the Polytechnic Institution, in which, in my then innocence, I inadvertently gave the scientific world credit for much more than it was entitled to, and on my arrival at the Institution, on the appointed day for the experiment, I was met by the Professors with the observation that when the machine was in operation the electricity was *from* and not *to* the machine, as I assumed to be the case. Here, then, was an unexpected difficulty, but after a few moments of reflection I requested that the apparatus might be put into action, and, notwithstanding the admonitions of the attendants, slowly approaching it, at about 4 ft., sent a vivid flash from my forehead to the boiler, and bending forward, most gracefully of course, I discharged several others. Had the flashes been from the boiler, evidently a coroner's inquest would have told the tale; that fact, however, conclusive as it was, was not sufficient to gain for me a hearing, but, on the contrary, with others of a like nature, produced the first fruits of discovery—persecution—although to that persecution Truth is more indebted a thousand fold than if I had become one of society's pampered few.

In my letter of 1845, to the directors of the Polytechnic Institution, I stated that the elements of water were held together by electricity, the combining agent, and some ten or twelve years later Prof. Faraday averred that in a drop of water there was sufficient electricity to fell an ox. Of the quantity I do not profess to have the most distant idea, but be it what it may, on the exposure of the water to matter in a highly negative state, such as the products of combustion, a portion of that electricity is withdrawn, and steam is generated. So long as that steam is under only the ordinary "pressure of the atmosphere" it will continue to escape in a negative state, and scald the hand if presented to it; but if it be subjected to compression, there is an accumulation of electricity proportional to the compression, *with a corresponding decrease in temperature.* When, then, the steam of the boiler was allowed to escape it carried with it its electricity, and as the fire was constantly generating negative steam, to supply the demand there was a constant flow of electricity *to* the boiler. When a gun is fired there is a flash at the mouth, and as all the gases resulting from the combustion of gunpowder are inimical in the extreme to both light and life, the flash can be nothing else but electricity produced by compression, whilst the report is not altogether dissimilar to the thunder that follows the lightning flash.

I would suggest, then, to the inventor and promoters of this air compressing machine, which is in every sense an electrical battery, that before going to the expense of applying it to a mine, they repeat my experiments of 1846, with the freezing mixture and solution of alum, an account of which will be found in No. VIII. of the papers by "S.," of 1849, on my discoveries in natural philosophy, substituting, however, their machine for the freezing mixture; and if on the compressed air being made to discharge against an insulated ball of fine copper wire, connected with a solution of alum, crystallisation should result, as I am sure it will, they may depend on it that so far from their machine having an influence on the whole of a mine, the cold will not be perceptible at more than a few feet or inches from the discharge. The walls and other parts of the mine must necessarily be in a negative condition, and those walls, &c., are good conductors, whilst air is the worst conductor of that condition understood as cold.

I am now in the midst of sand hills, *capped* with gigantic masses of iron, and on a future occasion I may trouble you with the facts of the formation, in reference to my papers on the facts of the sand formation of the South of the Isle of Wight basin; between the two, so far as I have seen, there appears to be a strange unity of purpose, although so entirely dissimilar. FRANKLIN COXWORTHY,

Wrecclesham, Farnham, Dec. 8. Author of "Electrical Condition."

MINING ENTERPRISE IN NORTH STAFFORDSHIRE.

SIR,—If mining enterprise has flagged or declined in South Staffordshire, it has of late increased in greater proportion in the northern division of the county. The mines increase in number, they become richer, and lie deeper in the North than the South, so that it needed new and improved appliances to develope them. Cannock Chase, still a rude and primitive tract of country, is fast being parcelled out into mining lots, under enterprising companies; roads have already been made where none before existed; and miles of private railways have been laid down, to convey minerals to the great centres of consumption. What is known as the Pottery coal field has been worked from the time of Dr. Plot, who, in 1686, gave a description of the measures, their qualities, and those of the iron made therefrom, as well as the quantity made, which, it might be interesting to state, amounted to from 2 to 3 tons in 24 hours—a quantity so great in the apprehension of this worthy professor of chemistry, that he takes the precaution to tell us it was procured from a furnace of great improvement over the methods of our ancestors, who made iron in "foot-blasts or bloomeries, by men treading the bellows, by which way they could make but one lump of bloom or iron in a day, not weighing 100 lbs., leaving as much iron in the slag as they got out." From the learned professor's account it appears that it was only at the basset or outcrop that the measures were worked; and even now, where the measures lie deep, little has been done till within the last few years to make them available. A number of old abandoned mines are observable on passing through the western portion of this coal field, where only the upper and inferior measures have been worked, and where no attempt was made to reach those at greater depths. This portion of the field is intersected by numerous faults, two or three of which, crossing the Leycett Colliery, cause a downthrow of 200 yards. On this, the western side, no attempt was made to reach the richer and lower measures; but the present enterprising company who have taken the old Silverdale and Madeley Works, and secured rights over some 4000 acres altogether of Lord Crewe's estate, are putting down improved machinery, wider and deeper shafts, extensive railways, and are in other ways preparing to develope the whole western tract of country on the side where the Permians set in. So important is this district becoming that the North Staffordshire Railway Company, in addition to an accommodation branch, have constructed a line of railway 12½ miles long, from Silverdale to Market Drayton, by which means the colliery proprietors of Silverdale, Madeley, and that district, will have direct communication, not only with the rich agricultural district of North Shropshire, but with Crewe, the great centre from which important lines radiate in all directions.

On the Market Drayton side of the North Staffordshire coal fields mining operations have not yet been attempted, except at Madeley, where the basset edges of the upper measures have been met with; and at Child's Ercal, where Mr. Corbet is boring in search of coal. Very many years, however, we imagine, will not elapse before the mines, which undoubtedly underlie the red rocks of this district, will be developed to a very large extent. The new line of railway above alluded to, which it is expected will be opened in the first week of January next, has conferred a favour upon geologists by its deep cuttings, in which upper coal measures and Permian sandstones are exposed, together with faults which intersect them. One fact struck me as important—that although there appears to be a striking difference in the occurrence of iron ores in the upper workable mineral seams from South Staffordshire, Shropshire, and South Wales, yet that the upper unproductive measures have a very close resemblance to those of South Staffordshire and Shropshire, particularly those in connection with such poor measures as occupy positions from which the older and lower measures had been swept away by denudation. Mr. Macay, the skilful and able engineer under Messrs. Brassey and Field, who has had the entire charge of the construction of the line, told me that he too was struck with them, and could easily identify them. The fact that the upper workable seams, like the blackbands, come in and go out between the east and west sides of the Pot-

tery coal field, at the same time retaining their entire thickness, would seem to furnish additional evidence that the denuding agent which planed down the inequalities of the Shropshire and South Staffordshire fields extended its action to North Staffordshire also, and that then were laid down by a body of water those clays, and marls, and sand rocks which, with very thin coal seams intervening, cap the workable coal measures, and have a total thickness of from 500 to 1000 feet.—*Madeley, Dec. 6.* J. R.

BRITISH COPPER MINING.

DEAD RENTS, AND ROYALTIES.

SIR,—I beg respectfully to enquire through your columns if any person can give satisfactory reasons for Dead Rents, as I know of none myself? I have been over a great deal of copper property in England and Ireland, and, as a general rule, the surface of these properties is of no value beyond grazing some sheep or goats, and, it may be, a few cattle. Instead, therefore, of owners of such properties exacting a dead rent, to my mind it would be more like the thing were they to offer a premium to respectable and competent parties to explore them. I should, however, readily grant that surface damages be paid for. Then as to Royalties. My decided conviction is that none should be exacted until a mine begins to make profits, and that they should be very much less than they have hitherto been. How many mines have never been able to meet more than their costs, and that too after every skill and economy have been brought to bear upon them, whilst the only parties benefited have been the lords. All business, I need not remark, should be carried on to the advantage of all connected with it, but in the cases to which I have referred *it is all one-sided.*

What, too, should weigh much with owners of British copper property, with the view of doing away with dead rents, and, at least, most materially reducing royalties, is the great foreign competition British mines have to contend with. It has been very transparent for years past that foreign mining companies, particularly those in Chili, have quite controlled prices of copper in this country, and whether or not this is to continue remains to be seen. It is, however, a great fact, and one which the owners of British copper property would do well seriously to consider, if copper mining in this country is to maintain the footing it has so long held. OBSERVER.

ANGLO-PRUSSIAN MINING COMPANY.

SIR,—In the notice of this mine, in last week's Journal, a mistake occurs as to the situation of the mines intended to be purchased; they are therein stated as in Siegerland (should be Siegenland), instead of in Rhenish Prussia; the former is noted for its iron mines, the latter for lead and blende. I would call your attention to the quantity of the latter mineral stated by the Government reporters to be seen in the mine as a confirmatory indication of the correctness of this statement; and I may add that during the last year of the original proprietors working this mine the quantity of blende returned per lachter was 4 tons, and 1½ ton of lead.

AN OLD, AND WILL BE NEW SHAREHOLDER.

MINING IN MEXICO.

SIR,—I have received several letters requesting me to give information relative to the Guatimotzin Mine of Real del Monte, and I imagine the most satisfactory, as the most reliable, course will be to quote my brother's letter by the last English mail from Mexico.

2, *Westbourne-terrace-road, Dec. 7.* HENRY SEWELL.

We are expecting a great "bonanza," or a great discovery of ore. Doctor Chester has 1-12th in this mine. In the San Francisco level, which is 125 fms. below the Rosario adit, and some 200 fms. from surface, they have already driven through some 12 fms. of good metal, the width being 4 ft., of which 10 in. is rich ore; the average will be 130 ozs. of silver per ton. The San Francisco level must be now some 140 varas into Guatimotzin, driven in from the Rosario Mine (the great Real del Monte Rosario). This will be good news for Mr. G. F. Smith and other shareholders in England; and had these gentlemen followed my advice, they ought to have commissioned somebody to inspect the mine closely, and have received a faithful report. They could all sign one power of attorney to receive their dividends here, as some of the shareholders in England did not receive their dividends for ten months after they were paid here. I shall have no objection to be useful to them, as I represent 1-12th of Guatizmotzin for Doctor Chester, and I would be able to get them a better exchange on England.

Casa Grande, Real del Monte, Oct. 25. J. P. SEWELL,
Treasurer of the Real del Monte Mining Company.

MINING IN COLORADO—NEW ORE SEPARATOR.

SIR,—The Krom separator is doing well here on silver ores. We now want more carriers to set mining afloat, or some joint-stock companies, with capital, to send the ores to England, as the mines can be worked to much greater profit by so doing. The gold lodes here contain a very high percentage of copper, and when those ores are sent to the stamp-mill the copper carries a large proportion of gold over the plates, and is, therefore, washed away; this ore should consequently be sold to the smelter. A great many of the lodes contain gold, silver, copper, lead, and blende, and when taken to the smelter the miner has to state the metal it is to be sold for; it is usually sold for silver. It must be worth $80 per ton for silver before the miner gets 1 cent for the ore. For all silver over $80 per ton the miner gets 55 cents per ounce in greenbacks ($1 in greenbacks—3s. English), but if this kind of ore were sent to England the miner would receive the value of all metal and mineral, therefore the mines could be worked at a much larger profit. Many of the lodes here could be worked at a profit at once if there were capital in hand to pay the labour and freight until the returns were obtained from the ores sold.

At the Washington Mill, where the Krom separator is in use, the machinery and mode of operating for dry concentration is well worthy of inspection. The ore is first dried in a brick oven, about 20 ft. by 5 ft., the three feed doors being on one side, and the three discharge doors on the other. The fire passes over the ore only, and the floor of the oven slopes towards the discharge doors. This oven will dry 2 tons per hour. Near the discharge floor stands the improved Dodge crusher. The jaws and the Cornish rollers crush it fine enough for the bolt. The ore is then raised to the top of the building, and passed into the bolt by a screw feed. The first section of the bolt is covered with wire screen of the fineness of 100 meshes to the inch. This is protected by a coarser screen on the inside, which carries the weight of the ore. A fan is stationed near by the bolt that draws all the dust and fine material out of the bolt through itself, and blows it through three 16-feet chambers, situated one over the other, and connected. The dust and fine ore falls in this chamber into partitions, according to its specific gravity. That falling first is, of course, the best. This is drawn off into a common dust receptacle, just so far, or just so many partitions from the pan, as experience or assay determines its contents to be valuable. With the gold ore from the Briggs Mine all that was of any value fell in the first chamber, while with some silver ores the fine sulphurets are blown more than half way through the chamber. This dust with silver ores is usually found to be from two to three times as rich as the original ore, and being too fine for further concentration it is ready for treatment. To return to the bolt. That portion of the ore too coarse to pass through the first fine screen passes on to a second section, with the screen about No. 40. What passes through this falls into a hopper below, and is deposited in its appropriate bin. The next section of the bolt has No. 25 screen, and the next No. 12, thus sifting the ore into three sizes. What passes the No. 12 screen is returned to the crusher. These different sizes of ore are then fed separately into the concentrating machines upon the lower floor. The principle of this machine is identical with that of the water jig, only that the ore is agitated by air instead of water. The ore falls upon a table 5 in. wide and 4 ft. long, composed of wire tubes with spaces between. The fan in the machine makes 480 puffs per minute, thus keeping the ore in a continual agitation, the heavy ore falling to the bottom to be removed by a roller, and discharged on one side of the machine, while the light gangue is kept on the surface, and falls over into a receptacle on the other side. To make the separation complete, Mr. Jacobs, the energetic manager of the works, puts it through the machine twice. With the three machines in use he can separate 1 ton per hour. The common observer would pronounce the work perfect; but Mr. Jacobs frankly points out two faults in the process, and also points out so simple a remedy that any mechanic can see that it will entirely obviate the difficulty. These concentrators can handle any ore that can be concentrated by any process, and perform the work much cheaper. The only manual labour required is the passing in and raking out of the drying furnace, the shovelling into the crusher, and the removal of the concentrated ore and the gangue. The works are run by a 12-horse power engine, with 20 lbs. of steam.

The gold mines in Colorada are paying well. The California Mine is at present taking the lead, but it is expected that West California will shortly open up and prove the best mine in the mountains. Their shaft is now down about 100 ft., and they are taking out a quantity of rich ores—rich in gold, silver, copper, lead, and blende. A box of the West California ores has been packed to be forwarded to the *Mining Journal* for the inspection of those interested. Labour is cheap, and the largest engine in the mountains is a 22-in. cylinder. All kinds of materials are also cheap. Bucklin and Babcock, and Virginia Canyon are looking well. From the California Mine Messrs. Stalker and Stanley sold six bars of gold this week to Warren, Hussey, and Co.'s bank for $4500—the product of four days run at the Pleasant Vein Mine. The smallest weekly return has given 100 per cent. net profit. At Baltimore Mine, in Clear Creek, the lode is 9 in. wide, and assays $450 per ton; it was struck at 150 ft. from surface.

Central City, Colorado, Nov. 12. THOS. JENNINGS.

AUSTRALIAN UNITED GOLD MINING COMPANY.

SIR,—On June 19 Mr. Kitto advised the starting of 24 stamps, which work admirably, and hopes to crush 700 or 800 tons by the next mail. Three and a half months later 340 tons were crushed in the four weeks ending Oct. 11—200 tons of which yielded about 6 dwts. of gold per ton. The 55 ozs. previously reported, ex 80 tons, now appears to have been only 42¾ ozs., or 10 dwts. per ton, instead of 13 dwts. At this rate of progress, where is "the dividend by the end of the year" to come from?

Would it not be better for the Australian United shareholders if the manager were to give his undivided energies to the Anglo-Australian Gold Company? One reason assigned by Mr. Lamb for the stamps standing still—that the construction of buddles would be delayed by the flow of tailings,—is illustrated by Mr. Kitto crushing 300 tons for neighbours. They probably did not expect "2 ozs. of gold per ton of tailings." START THE STAMPS.

RICH SILVER ORE IN CORNWALL.

SIR,—Your last week's correspondent, Mr. Wm. Eathorne Gill, reads in the prospectus of a company that the assay of a specimen of silver ore gave 3253 ozs. of silver to the ton, and from his language he seems at once to have jumped to the conclusion that the object of the said company in making this statement was to delude the public into the belief that the lode of silver ore was of this uniform richness. Had he read further he would have seen that the company had carefully and completely provided against such a delusion. Surely, Sir, the statement has been made plain enough—plain enough, I say, beyond all possibility of mistake, that the average value of the lode of silver ore is not 3253 ozs. to the ton, but such number of ounces as would amount te 28*l.* per ton.

G. K.

NANTEOS CONSOLS.

SIR,—My letter last week was written with the intention of drawing the attention of shareholders to the very low price of the shares in this mine; and I thought that through no other channel could I do it so effectually as through the Journal. I well recollect the opening of the Lisburne Mines in this county. These shares were issued at 75*l.*, and, from discoveries, in a few months reached the figure of five hundred guineas. The Goginan, issued at 5*l.*, reached 420*l.* in a few months. The discoveries in Nanteos Consols are equal to either of them.

Goginan, Dec. 7. ABSALOM FRANCIS.

[For remainder of Original Correspondence, see this day's Journal.]

MINING IN NEVADA (U.S.).

The White Pine Silver Mines district, within an area of seven miles, contains three towns—Hamilton, Treasure City, and Shermantown—and has a population of about 12,000 inhabitants, and two years ago was almost unknown. The principal mines are situated on Treasure Hill: here is the celebrated Eberhardt, which was the first located in that district, and up to the present time it has yielded more bullion than any other six mines, and may be considered as the representative mine of the district. The Hidden Treasure, Aurora, South Aurora Consolidated, Poganip, Othello, Mazeppa, Domingo, and others show immense bodies of ore, and in time some of them may come to rival the Eberhardt; but at present the Eberhardt is a common expression all over the Pacific Coast, as the strongest compliment the language admits of. The owners are five in number. The mine, as it now stands, consists of two claims, the Keystone and Eberhardt Consolidated. They were originally located as portions of a vein cropping out along the eastern edge of the mountain, at the southern end of the Peak, and running north and south; but it was subsequently decided the ledge run east and west directly into the hill, and the Court, before which a suit involving the title to a portion of the ground was being tried, allowed the owners to swing the claim around, and run along the vein, as is customary in mining countries. The first locaters, or a portion of them, sold out for a mere song, before its value was ascertained. The Eberhardt is now an incorporated stock company, with a nominal capital of $12,000,000, but the stock has never been placed on the market, and is all owned by five persons. All were comparatively poor two years ago. The amount of bullion taken out of the mine since they commenced, which is nearly two years, is the enormous sum of $2,000,000, and for the first 13 months the company only owned a small 10-stamp mill, and could only keep half a dozen men at work taking out ore for want of a place to store it. Since they have had milling facilities the yield has been enormous. Not a dollar has been levied by way of assessment on the stock, and the dividends have made all the owners rich already. The mine is an anomaly every way, and its history is unprecedented.

The White Pine discovery has caused the whole country, within 200 miles around, to be well prospected, and the result is the discovery of district after district, which will yield greater or less amounts of bullion for years to come, and some of which may rival White Pine itself eventually; among these districts are the Pinto, Eureka, Diamond Kern, White Cloud, Robinson, Grant, Eli, Belmont, and a dozen others, which a year ago did not yield a dollar of bullion; all these will yield more or less next year, and some of the mills which are being erected will turn out immense quantities. The yield of silver at the White Pine alone next spring will amount to $100,000 a week.

FOREIGN MINING AND METALLURGY.

The blast-furnaces in all the metallurgical districts of Prussia are putting forth their full strength, but they can still scarcely produce the quantities of rough iron and pig which siderurgical industry requires to meet the current demand. There is, consequently, some demand also for English and Belgian pig, and there is scarcely a ton of pig on hand which is not sold or bespoke. Nevertheless, the imports from England do not attain the great totals of former years, probably because the home consumption of that country has also been increasing of late. The market for iron in bars continues in a very animated state, and the rolling-mills are scarcely able to produce the quantities of iron ordered from them. Manufacturers stipulate for rather extended periods in connection with new deliveries. The market for rails maintains a favourable appearance. During the last week or two the Nassau Railway Company has ordered 600 tons of ordinary iron rails, and 33 tons of accessories; and the Saarbruck Railway Company 2750 tons of iron rails with accessories. The production of steel is increasing from day to day in Prussia; many works which have hitherto produced only iron are now enlarging their establishments, with a view to the manufacture of cast-steel. It is especially rolling-mills for rails which are turning their attention to the production of steel, in order to make steel rails, which are at present more in demand than iron ones.

The exports of pig from Belgium amounted in the first eight months of this year to 11,089 tons, against 11,285 tons in the corresponding period of 1868, and 7138 tons in the corresponding period of 1867. The exports of Belgian pig to the Zollverein appear to have greatly increased during the last two years, while those to France have declined. The exports of rails from Belgium have acquired considerably increased importance this year, having amounted in the first eight months of 1869 to 103,746 tons, against 45,188 tons in the corresponding period of 1868, and 65,090 tons in the corresponding period of 1867. The annexed table shows the countries to which Belgian rails have been exported during the first eight months of the last three years:—

Destination.		1869.	1868.	1867.
Russia	Tons	49,410	33,139	56,045
Sweden and Norway		730	—	—
Zollverein		4,024	4,377	22
Hanse Towns		—	106	147
Low Countries		2,214	1,576	2,701
England		1,010	3	25
France		477	471	510
Spain		36	15	53
Switzerland		30	—	—
Italy		10,729	3,615	5,533
Turkey		26,748	—	—
United States		6,625	752	—
Rio de la Plata		220	—	—
Other destinations		1,495	1,134	54
Total		103,746	45,188	65,090

The total attained in the first eight months of this year exceeds that established in the whole of 1868 or the whole of 1867, and a considerable addition to the return for 1869 will, probably, be made by the last four months of the year. The exports of plates from Belgium in the first eight months of this year attained a total of 14,602 tons, as compared with 8696 tons in the corresponding period of 1868, and 8700 tons in the corresponding period of 1867. The outward movement of merchants' iron from Belgium shows a serious augmentation this year, having been 55,042 tons to Aug. 31, as compared with 46,149 tons in the corresponding period of 1868, and 35,891 tons in the corresponding period of 1867. The imports of iron minerals into Belgium in the first eight months of this year amounted to 376,924 tons, against 262,255 tons in the corresponding period of 1868, and 194,212 tons in the corresponding period of 1867. The imports of pig into Belgium in the first eight months of 1869 were 31,981 tons, against 26,316 tons in the corresponding period of 1868, and 38,166 tons in the corresponding period of 1867. The exports of coal from Belgium in the first eight months of this year amounted to 2,185,392 tons, against 2,249,378 tons in the corresponding period of 1868, and 2,187,900 tons in the corresponding period of 1867. The exports of coke from Belgium show a more favourable result, having been 424,137 tons to Aug. 31 this year, against 343,695 tons in the corresponding period of 1868, and 357,794 tons in the corresponding period of 1867. Although the exports of coal from Belgium show a decline this year, so far as the statistics have been made up, it is doubtful whether the deficit will not be made good before the year has expired. At present, at any rate, the state of the Belgian coal trade may be said to be flourishing, orders coming forward freely.

The most striking fact of the last few days in the St. Dizier district has been the announcement of a metallurgical meeting, which will be held at St. Dizier on Dec. 19. The Champagne committee of forgemasters has addressed on this subject a letter to the forgemasters and manufacturers of charcoal-made iron in France, inviting them to assist at this meeting, and numerous adhesions have been already received. The Consultative Chamber of Joinville, at its last sitting, energetically denounced the treaties of commerce, and called for the enactment of a new customs law by the Corps Legislatif, after a full parliamentary enquiry. Business continues active in the Haute-Marne, and previous prices are firmly supported. The town of Chaumont is about to let a contract for water-pipes, the cost of which is roughly estimated at 3150*l.* The syndicate of Franche-Comté forgemasters has been once more discussing the eternal warrants question, and grumbling about the competition of Swedish iron. The syndicate has called—first, for a denunciation of the English treaty of commerce before February 4, 1870, since the treaty will otherwise continue in force, even without the sanction of the Corps Legislatif; secondly, for a revision of the system of warrants; and, thirdly, for a parliamentary enquiry into "these grave questions." Fine pig, although showing firmness on the Comté markets, remains without affairs; the position of the producers is pronounced most unfortunate. An advance of 8s. per ton in merchants' iron is stated to have been established by the forgemasters of the Centre and the South. A meeting of forgemasters connected with the Meurthe and the Moselle has been held during the last few days at Nancy. The organisation of a committee has been proposed in this eastern group of France, and more particularly the establishment of a *comptoir general*, for the sale of pig in common. It seems probable, however, that certain industrials will still feel inclined to preserve the advantages of the respective positions of their works; and it is certainly only just that superior products should still maintain their hard-won reputation. A contract for 100 tons of wire, to be used in connection with a submarine telegraph cable, was recently proposed for competition at Paris; but the lowest tender being above the reserve price fixed an adjudication did not take place. The total imports by warrants into France in the first nine months of this year were 50,986 tons of pig, 19,505 tons of iron, and 2654 tons of plates, against 35,246 tons of pig, 15,903 tons of iron, and 2792 tons of plates during the corresponding period of 1868. The re-exports from France after the application of manual labour to the material temporarily imported amounted in the first nine months of this year to 43,707 tons of pig, 21,630 tons of iron, and 3687 tons of plates, against 31,684 tons of pig, 19,422 tons of iron, and 3822 tons of plates during the corresponding period of 1868.

IMPROVED BORING APPARATUS.

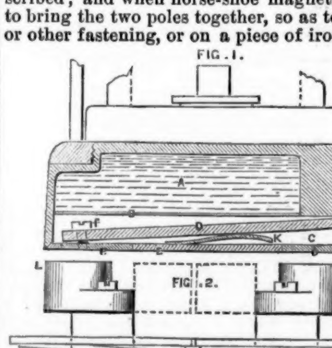
An ingenious apparatus for boring, which has the advantage of being of only 40 or 50 lbs. weight, has recently been invented by Mr. F. F. VILLEPIGUE, of Northumberland-street, Strand. It is an apparatus consisting of a fixed hollow column, which contains at one extremity a screw with a pointed end, and at the other a pedestal with jointed claws, which adjust themselves to the nature of the ground surface, and prevent the column from turning on its axis, at the same time giving facility to the operator to incline it at any required angle; whilst the fixing screw placed in the interior of the column, and thus secured from outward concussion, being surmounted by a perforated capping, by which its adjustment can be regulated, has at its extremity a sharp point capable of penetrating the rock. The column being thus fixed, the boring apparatus proper may be made to slide along its whole length, to describe a circle in the horizontal plane by turning all round with the column, and, by a special arrangement for that purpose, to describe likewise a circle in the vertical plane; it can thus be made to act in any required direction without altering the position of the main column. The perforating apparatus consists of a double screw, with external collar, acting as a moving force with its break, a friction roller, a casing forming a butting piece whilst enclosing these several parts, the bar in which the blade is fixed, the perforating blade, and a crank catch handle.

The advantages claimed for the new machine are very numerous, and the inventor claims that the perforators are based upon the principle of a constant equilibrium between the motive force and the resistance offered—that is to say, that a self-acting and incessant equilibrium is established between the resisting forces and a regular and constant motive force applied by means of the handle or crank of the machine, which regular and constant force is made to produce, by the agency of mechanical combinations designed for the purpose, a variable differential movement, which is always proportional to the hardness of the material that has to be pierced, the machine thus regulating automatically the amount of progress it is capable of effecting with relation to the resistance to be overcome, the amount of power exercised by the crank or handle being uniform when set to work, but at the same time capable of being increased or diminished at the will of the operator.

ELECTRIC LOCK FOR SAFETY-LAMPS.

In referring to the *conversazione* at the Institution of Civil Engineers in May last, the electric lock for safety-lamps, invented by Mr. W. Y. CRAIG and S. P. BIDDER, jun., was alluded to as one of the most important exhibits; and, as the precise details of such inventions are at all times of considerable interest to practical men, an illustrated description of the arrangements employed is now given. The invention consists in securing the wire gauze or other casing of the lamp by means of a bolt, or similar fastening of iron and steel, inside the lamp, and held in is place by a spring, but which bolt, on the application of a magnet to the outside of the lamp, shall, by the attractive power of the magnet, be withdrawn, so as to allow of the wire gauze or other casing being removed. Various arrangements of the fastening may be employed in carring the invention into practice—thus, a bolt may be made to pass vertically through the bottom part of the lamp, and be caused by a spring pressing against the under side thereof to project into a recess in the rim of the casing when this is screwed on, so that when the magnet is applied the bolt is drawn down, so as to allow of the casing being unscrewed. Or the bolt may be made to pass through the side of the bottom part of the lamp into a recess or notch in the side of the rim of the casing which may in that case either be arranged to unscrew or to turn on a hinge; or the fastening may be in the form of a pawl, catching into ratchet teeth, formed on the inner surface of the rim of the casing, which pawl is carried on a spindle having an arm which, by being attracted by the magnet, withdraws the pawl from the ratchet teeth; or various other similar contrivances may be employed, whereby the application of a magnet to the outside of the lamp causes a spring fastening to be withdrawn inside the lamp. The magnet employed for this purpose may be either a natural, a permanent, or an electro-magnet brought into action at the required moment by a galvanic battery or other apparatus for producing a current, or an electro-magnet apparatus may be employed wherein the residuary magnetism in a bar of soft iron is increased to the required intensity by the reaction of electric currents, induced in the armature and magnet coils by the forcible rotation of the armature. The magnets may be conveniently contained in a stand or table, so arranged that the lamp to be opened when placed thereon shall be in correct position for the poles of the magnet to act upon the bolt or other fastening, as described; and when horse-shoe magnets are employed is is preferred to bring the two poles together, so as to act powerfully upon the bolt or other fastening, or on a piece of iron or steel attached thereto.

FIG. 1.



In the annexed diagram Fig. 1 shows a sectional elevation of a safety-lamp, with the improved system of locking applied thereto. For this purpose the oil chamber, A, of the lamp has a double bottom, B, beneath which is formed a second chamber, C; in this chamber is a piece of iron or steel, or armature, D, secured at one end loosely to the bottom, E, by means of a screw, *f*, while at the other end it carries (also loosely) a pin or bolt, G, passing up through a hole which is formed for the purpose in the body of the oil chamber, A, and into a recess or notch, H, in the rim of the upper part or casing, I, thereby locking such casing on to the lamp. The armature, D, is held in this position by means of the steel spring, K, secured to the bottom, E, and made to press the armature upwards. In order to unlock the lamp for lighting, the bottom thereof is placed in contact with the poles, L L, of the electro or other manget, M. Fig. 2, whereby the armature, D, in being attracted by such poles with greater force than that exercised by the spring, moves downwards towards them, and thereby withdraws the bolt, G, from the notch, H, thus allowing the casing, I, to be unscrewed. On screwing on the casing again (after lighting the lamp and removing this from the poles of the magnet, M, or simply breaking the current if an electro-magnet is employed), the spring will again press the armature upwards, thus causing the bolt, G, to enter the notch, H, again, so as to lock the lamp. The lamp, A, being

made of brass, it is preferred, in order to increase the action of the magnet upon the armature, to let into the bottom, E, two pieces of iron or steel, *e e*, at those points where the poles of the magnet come in contact therewith, and in cases where the magnet is required to act upon lamps having different arrangements of the armature the poles, L L, are preferably made adjustable, as indicated in dotted lines. The spring, K, being sufficienty strong to prevent the withdrawing of the bolt by any mere jerking down of the lamp, it will be seen that the unlocking of such lamps by any other person than the man who has charge of the magnet is rendered impossible.

PRACTICAL METALLURGY—STEEL AND FUEL.

Whatever cause may have existed a few years since for the complaint that England was worse supplied with metallurgical literature than continental nations, it may safely be said that it exists no longer. In addition to the several metallurgical works which have recently been published in this country, we have now the concluding volume* of Messrs. CROOKES and ROHRIG'S English edition of Kerl's well-known and standard treatise—a work which undoubtedly stands first in reputation in Germany, and one which, with the emendations and additions introduced by the editors in adapting it to the requirements of Englishmen, will certainly attain an equally good position here. The third volume, that now under consideration, contains the chapters on Steel and Fuel, together with the Supplement, Glossary of Terms, Index, &c., necessary to render the work complete, and is an exhaustive treatise on this portion of the subject. It is very properly explained that, although the authors have taken the admirable treatise of Professor Kerl as the groundwork of their labours, they have given much practical information and many useful processes not to be found in Kerl, as will readily be understood when it is considered that whilst Kerl's last edition was published in 1865, Messrs. Crookes and Röhrig's book contains accounts of processes even as recent as Heaton's, Lurmann's, Ellerhausen's, and others, which still rank amongst the novelties of the day.

Steel differs from wrought-iron in its proportion of carbon, which varies from 1·4 to 1·5 per cent.; it differs from pig-iron in its property of welding, and from wrought-iron in its fusibility; steel is furthermore characterised by its softness at a glowing heat, and it becomes hard upon sudden cooling. These properties are modified by various circumstances, which are not yet well understood. The principal methods of making steel are carefully described, and the classification of steel is then given—first, according to the treatment it undergoes, and then according to its application. After a record of the bibliography of the manufacture of steel, the properties, constitution, theory of hardening, and influence of foreign admixtures on the properties of steel are fully referred to. The various processes for the production of steel from raw materials having been described, the authors next explain the processes employed for its production from wrought-iron by cementation; the materials necessary for the manufacture of cement steel, cementation-furnaces, and method of conducting the process, being given in considerable detail.

With regard to the production of imitations of damasked steel, Messrs. Crookes and Röhrig give an admirable account of the method adopted at the Don Steel Works, Sheffield. It was introduced by Mushet in 1801, and consists in melting malleable scrap iron with charcoal and oxide of manganese, in crucibles directly, without using any blister steel. The furnaces are 288 in number, each being of sufficient size to contain two pots, charged with 100 lbs. With the whole number at work a casting of 25 tons weight may be made, the pouring of the 576 pots being completed in five minutes. In order to keep up the supply, the pots are conveyed from their melting holes to the casting-place, on small barrows, instead of being carried by tongs, as was formerly the custom. The steel produced is to a great extent employed in making castings for immediate use, such as railway crossings, wheels, and bells, instead of being run into ingots to be subsequently worked up under the hammer. The moulds used for this purpose are made sufficiently refractory by the use of a thin layer of burnt clay produced by grinding old melting pots; this is applied immediately over the pattern, the remainder of the box being filled with ordinary moulding sand. This method of steel casting was first practised at Bochum, in Westphalia, where it is still carried out on a very large scale. Castings made to pattern, and not intended to be subsequently hammered, must be annealed, and allowed to cool very slowly. A very similar process has recently been introduced in the United States by Messrs. Smith, of Philadelphia, for casting iron and some artistic specimens recently exhibited at the Boston Institute of Technology excited great admiration.

The application of peat in connection with the manufacture of iron is a subject in which must interest has long been felt in this country, and the reference to it in the present volume is very ample, the chapter on turf being a complete record of all that has been done of any importance in attempting to apply it. The classification and composition of turf having been described, the chief methods of condensing it, both in the wet and dry way, are given. Messrs. Crookes and Röhrig state that when turf is condensed in the wet way, without pressing, it is triturated either by treading upon it with the feet, by kneading and beating it with iron rods (Holland, North Germany, South Germany), or by machines (Haspelmoor, Montauger, Rheims, Sweden, and Ireland); the turf is thus rendered more compact, and, consequently, less hygroscopic; it also dries easier, and more perfectly. Turf that has been cut is sometimes triturated by means of rollers. A well-conducted trituration condenses turf to one-fourth, and even one-sixth, of its original volume, and perhaps may, therefore, perfectly replace the difficult and more expensive method of pressing. In order to facilitate the drying of the triturated turf, it is requisite to add as little water as possible. When a perfect elutriation, with a large addition of water, is employed, the specific gravity of the prepared turf will increase, but on the other hand, the turf does not gain in consistency and heating power. The expenses are also considerably greater, and it is difficult to work large masses—this is why Exter's method has been abandoned at Haspelmoor, in Bavaria. The prepared turf is best dried under sheds, and after drying it is less inclined to absorb water again than the original turf. This method of preparation is particularly well adapted for turf of the older formation, which contains a large amount of inorganic substances.

The opinions on the methods of pressing freshly cut turf, which are entertained by the different investigators vary widely; this, however, may be explained by the peculiar behaviours of the various kinds of turf. Whilst more or less favourable results are obtained in the treatment of the light fibrous turf the earthy kinds present great difficulties, as the resistance of the water breaks the strongest machines, and fine particles of turf are also pressed out along with the water. By Mannhardt's method, which gave rise to great expectations some ten years since, the freshly cut turf is made to pass between rolls 6 ft. long, in which operation it loses 60 per cent. of its water, and forms thin plates, which can easily be dried. The Lithuanian method is very simple and inexpensive. The turf is ploughed, and divided by being frequently turned, and when air-dried it is pressed into cast-iron moulds by means of a rammer of 2 cwts. This pressed turf and the charcoal produced from it are said to perfectly replace mineral coal. The methods of condensing turf in the dry way by means of pressure, and by means of centrifugal power, are given in equal detail, and the uses of turf and its heating power are stated.

The whole of the chapters on fuel, and on the materials used in the erection of furnaces, are excellent, and the Supplement is, perhaps, the most valuable portion of the book; it contains excellent articles on the chemistry of the blast-furnace, the Schinz blast-furnace, the Richardson puddling process, Whitwell's hot-blast furnaces and hot-blast apparatus generally, Ponsard's method of producing cast-iron, Hargreave's system of separating phosphorus from iron, the Radcliffe process, the Ellerhausen process, blast-furnace economy, Jones's patent for iron and steel manufacture, Attwood's cast-steel and steel-iron patents, Lurmann's slagging system, Caron's method of purifying iron, Gjers' process of making cast-steel and homogeneous iron, Henderson's process for casting steel under high pressure, Bessemer's high-pressure hot-blast furnaces, Paul's researches on liquid fuel, Oxland's process for separating wolfram from tin ores, and a variety of others equally interesting.

So many additions and amendments have been introduced throughout the work by Messrs. Crookes and Röhrig that it is scarcely recognisable as a translation of Prof. Kerl's book, yet it must be admitted that had the volumes been even more Anglicised and modernised than they have they would have lost nothing in value, and Messrs. Crookes and Röhrig might have secured for themselves the honour of giving the country an original work instead of an adaptation; as it stands, however, the three volumes form a complete encyclopædia of metallurgy, which may be kept up to date with very little difficulty, and one which may be profitably studied by metallurgists, both young and old.

* "A Practical Treatise on Metallurgy" (adapted from the last German edition of Prof. Kerl's "Metallurgy".) By WILLIAM CROOKES, F.R.S., and ERNST ROHRIG, Ph.D., M.E. In three volumes. Vol. III.: "Steel, Fuel, Supplement." London: Longmans, Green, and Co.

MANUFACTURE OF IRON AND STEEL.—The invention of Mr. ALBAN MEREDITH, of Newgate-street, has for its object improvements in the manufacture of iron and steel. At the present time the Bessemer process can only be successfully applied to irons made from the hematite ores, and this arises, as he has found, from other irons not developing sufficient heat in the process of blowing for the separation of the impurities the metal contains. Now, according to the invention Mr. Meredith raises the temperature of the iron to a very high degree before beginning to force the blast through it by means of a refinery by fire in the usual way of making refined iron. In this preliminary process the impurities are in a great part separated, whilst at the same time the metal is raised to the heat necessary for the successful action of the blast passing through it. When this heat is attained, the metal is at once run into the Bessemer vessel and treated by the Bessemer process. The iron may be run direct from the blast-furnace into the refinery furnace. In some cases, before running the refined metal in the Bessemer vessel he introduces into it a quantity of cast-iron known as spiegeleisen, or it may be other highly carburretted iron, and finishes the metal by adding a further quantity of spiegeleisen at the end of the process. In the refining process he in some cases introduces fluxes of an oxidising or other nature into the air tuyeres, so as to cause such fluxes to be forced down into the metal. In some cases he uses steam together with the air in the refining process.

THE IRON AND STEEL INSTITUTE.

A general meeting of the members was held in the Lecture Room at the South Kensington Museum (the use of which had been granted by the Privy Council), on Thursday, Dec. 2,—the chair was occupied by Mr. I. LOWTHIAN BELL, the Vice-President of the Institute.

The CHAIRMAN, in opening the proceedings, said—

I will first state the order of our proceedings. In the first place there is some ordinary routine business to be dispatched, and after it has been completed, and the members elected, we shall then, with your permission, take up the reading of those papers left over from the last meeting, and after we have done that we shall then proceed to discuss the papers themselves, and also commence, and go as far as we can, with the discussion of the papers of to-day. The three papers which stand over are those by Mr. W. Menelaus, Mr. G. H. Benson, and Mr. Thomas Whitwell.

The minutes of the last meeting were then read by Mr. JOHN JONES (the secretary), and confirmed.——On the recommendation of the council, rule 17 will be altered, so that in future there will be two general meetings in each year, one of which will be held in London in the spring, and the other in the autumn, in such locality as the council may decide upon. The meeting in the spring will be the annual meeting for the election of officers. It will also be competent for the council to arrange for other meetings if they think it desirable. A slight modification was also made in rules 4 and 5, relating to the election of members.

The SECRETARY next read the names of the newly-elected members.

Mr. WILLIAM MENELAUS, of Dowlais, one of the Vice-Presidents, then read a paper "On Improved Machinery for Rolling Rails," of which the following is a short abstract:—

"I have long been of opinion that much may be done in the way of saving labour in our mills and forges by the introduction of improved rolling machinery and by the use of hydraulic power and other appliances for lightening the labour of the workmen, and in some cases dispensing with manual labour altogether. With this view labour-saving machinery has been introduced at the Dowlais "Big Mill." The piles for rails after being treated are passed through a While's blooming-machine. This machine consists of three pairs of rolls, two horizontal and one vertical, driven at a uniform speed of six revolutions per minute. The rolls are of different diameters, to suit the elongation of the pile. This machine requires no attendant, and the cost of labour is entirely saved. The piles are then re-heated in the second heating furnaces, and passed through a While's weighing-machine. This machine is in principle exactly like the blooming-machine, having three pairs of rolls, driven at the same speed—twenty-five revolutions per minute. This machine is placed close to the finishing rolls, and the pile when finished in the weighing-machine is passed to the finishing rolls by simple means. Here, again, the machine requires no attendant, and the labour in roughing is entirely saved. When the rail is finished rolling it drops upon a series of rollers, put in motion by gearing under the control of the sawyer, who without any assistance brings out the finished rail, and cuts it to length; it is then treated in the ordinary way. The piles are all drawn from the furnaces by hydraulic machinery, designed to suit the position of the furnaces. The result of these improvements is a considerable saving in skilled and ordidary labour, and in consequence cheapened production."

The CHAIRMAN said he was sure the members were very much indebted to Mr. Menelaus for the very sensible and able paper he had read. Any discussion on the paper must be reserved until the next meeting, but Mr. Menelaus would be happy to answer any questions.

Mr. WILLIAMS said he should like to ask Mr. Menelaus whether he saw any chance of carrying the system further—to the extent of finishing the rails altogether? If that could be done there was no doubt it would be a manifest advantage. At any rate, perhaps Mr. Menelaus would inform them whether, even if it were not possible to complete the rails, the system could not be carried out to the extent of giving them two or three grooves beyond the roughing? Dowlais, under the management of Mr. Menelaus, had made a creditable and successful attempt to improve the system of rolling, which had, to a considerable extent, been at a stand-still for some years.

Mr. MENELAUS said he quite agreed with Mr. Williams as to the advisability of carrying out the system further, but he did not see how it was practicable, looking at the orders now received by the ironmasters. A large French ironmaster had consulted him about a mill, and, seeing that in France they had greater quantities to make in the same section, he advised that instead of three rolls they should put five; but he thought that in this country, at present, it was better to stick to the three, and be content with an improved mill.——In answer to Mr. HEAD, Mr. MENELAUS said there was a saving of about 6½d. per ton by the arrangement.

On the motion of the CHAIRMAN, a vote of thanks was passed to Mr. Menelaus.

Mr. G. H. BENSON (Staleybridge) then read a paper entitled "On the Generation of Combustible Gases under Pressure." The paper, which was illustrated by diagrams, was of a very technical character, but we have not been furnished with an abstract. It will, however, come on for discussion at the next meeting, when we shall be able to give a summary of it.

Mr. THOMAS WHITWELL, of Stockton, read a paper entitled "On a Fire-Brick Hot-Blast Stove." The following is a summary:—

The earliest mention of practically heating airs to a high temperature is found as far back as 1817, when Robert Stirling, one of the ministers of Kilmarnock, invented and patented what is now known as the regenerative principle, and he proposed refractory substances—fire-brick, stone, metal, &c.—as the material for construction; his patent may be found in the Chancery for Scotland, dated Jan. 20 of the year mentioned. The first practical application of heated air in the smelting of iron was by Neilson in 1829, who, commencing with a temperature of 50°, gradually improved until in 1832-3 he had attained a heat in the blast of 600°, and this remained stationary for hot-blast until 1859 or thereabouts, when 800° was the general heat of the blast in the Cleveland district. In 1864 the upward movement may be said to have fairly commenced, 900° and 1000° were aimed at, and, after much destruction of cast-metal plant, most of the new Cleveland furnaces are now supplied with stoves of cast-metal pipes, containing 8000 or 10,000 square feet of heating surface per furnace. The gas system is carried to perfection; no coal is used, and an average temperature of blast of 1050° to 1100°, as indicated by Siemens's pyrometer, is attained. With the cast-metal system we cannot be expected to attain much higher heats without considerable mortality in the pipes. In 1865 the writer patented a fire-brick stove, especially designed for the practical application of blast-furnace gas as a heating agent, without the intervention of cleansers, and which could at any time be cleaned in the course of a few hours. A small pair were erected by him on this principle at the Thornaby Iron Works in 1866, and have been at work for the last two and a-half years without requiring any cleansing of the gas prior to use. The stoves are cleaned every three months from the outside whilst red-hot, and without being cooled down. The top doors are opened when necessary, and the dust removed from the vertical walls by scrapers with gas tube handles—the apparatus proved a complete success. About eighteen months ago the Consett Company commenced to lay down a full set of heating plant from the writer's plans; working was commenced in February last, and the working of the furnace is found to be very regular. Compared with a similar sized stove, working alongside, it was found that the saving effected by the additional heat obtained from the fire-brick stoves was equal to 25 per cent. Several continental firms are also applying stoves of this description to their blast-furnaces, and the writer is encouraged to hope that the iron trade generally will admit the advantages resulting from the use of his patent, which has been proved to be practicable and effective, and which he believes to be capable of effecting a much greater economy in the smelting of pig-iron than has been obtained from the use of any other description of plant. He further believes that his experiments, extending over the past four years (during which time his attention has been especially directed to the perfecting of the principle), have distinctly proved that additional temperature of blast has produced an exactly proportionate saving of fuel, and claims for his invention greater yield, greater regularity, greater economy, and improved quality.

This paper will also come on for discussion at the next meeting.

At the last meeting the CHAIRMAN (Mr. Bell) read a paper "On the Development of Heat, and its Appropriation in Blast-Furnaces of Different Dimensions." In accordance with the notice calling the meeting, this paper was now open for discussion.

The CHAIRMAN said that those gentlemen who were present at the meeting at Middlesborough must remember that he pointed out that when the furnace had reached the point 11,500 (indicated on a diagram), the temperature of the escaping gases was reduced to what he considered at the time was a minimum, and which he put down at 610°. This required a small amount of correction, for there was a small amount of heat added to the escaping gases, of which he was then unable to take any account. He had since obtained a tolerably correct view of the heat taken in by that circumstance. In the Cleveland district there was no furnace of such dimensions as to intercept as much of the sensible heat as possible: there were furnaces of 16,000 and 20,000 cubic feet, and up to that point the temperature of the gas was exactly the same. One of the North Country ironmasters, Mr. Morrison, put up a furnace of 33,000 cubic feet, and he believed there were furnaces being erected containing he did not know how many cubic feet. (A laugh.) He (the Chairman) was anxious to ascertain whether the views which he held respecting furnaces of 26,000 cubic feet held good with respect to furnaces of 33,000, and that he succeeded in ascertaining. In the appendix to his paper, which he had published, they would find a reference to a furnace of 80 ft. high, and containing 11,500—the number of units of cubic feet delivered—and that furnace, from the combustion of the coke, and the temperatue of the gas, had 57,197 units. The first office which this quantity of heat had to perform was to fuse all the materials descending the furnace, and, in addition, to decompose a certain amount of carbonic acid given from the limestone; and there was a claim made upon the reservoir of heat amounting to 50,313, leaving a balance of 6884 units; but in that furnace, in consequence of the perfect way in which it discharged its duty, there was an amount of heat arising from the decomposition of the ore. This amounted to 4928, so that the amount of gas when entered charged with 6884 had become charged with something like 11,000 units, and the consequence of that was simply to raise the line which he had indicated, and they had the whole 11,000 escaping at the top. A blast-furnace, instead of being an erection in which combustion was only going on at the bottom, was an erection at which they had a fire at both ends—so that he had no hesitation in saying, leaving out of sight loss from convexion and radiation from the sides, that the gases would escape from it at the temperature indicated, less the radiation. According to his view, they could not hope for any addition whatever to the furnace to quell the gases more than at present. He had visited the stoves of Mr. Whitwell, and he begged to tender his warmest thanks to the proprietors and to Mr. Whitwell for the courteous reception he had met with there; and he was bound to say that everything which Mr. Whitwell had stated in respect to the stoves had been realised. The furnace contained about 9000 cubic feet, and, using 22·75 cwts. of coke, was making iron charged with precisely the same materials as in furnaces alongside, heated with less blast, and using 18 cwts.; and in the appendix to which he had referred he had traced the whole process through, and accounted satisfactorily for the cause of saving. The important question to consider was how far the application of those stoves would render a like assistance to other large furnaces? Upon this point he had come to a very decided opinion—and his opinion was that they would do no good at all. All the good which could be done in a blast-furnace had already been done by enlargement. He would give his reasons. He would ask them to turn their attention to 6884 units; that was the capital he had on hand from his zone of fusion, and start for the zone of reduction. It was obvious he did not want any more heat; he had enough. There were 6884 of heat in the bank to draw upon—of heat developed by the reduction of the iron itself. He had 4530 from his coke, and 1200 from his blast. Now, anybody who had studied the action of hot-blast at all could not deny this—suppressing as far as the units got from coke, and allowing the units from heat used to take its place—that air is got there without any cost, and there was also three and a-half as much heat from the coal. The question to be discussed was this—Were there any circumstances in the chemical operations of smelting iron which prevented the suppression? In his judgment there was a formidable obstacle. In the ordinary blast-furnace, as they now knew it in its perfect form in the Cleveland district, the character of the oxidation of the gases as they came out of the furnace was a volume of 40 of carbonic acid to 60 of carbonic oxide. It might be asked—Why should we interpose any limit? The reason why is simply this—that the energy of carbonic acid while acting on metallic iron increases directly with temperature, whereas the action of carbonic oxide appears to diminish in inverse ratio. If they took a good quantity of carbonic acid, and passed it through iron at red heat, the proportion would be this—60 of carbonic acid to 40 of carbonic oxide; but if it was raised to a greater heat the power became so great that the static equilibrium became as 32 to 68; and if they raised the temperature to whiteness it required 90 of carbonic oxide to keep it in check, and 10 of carbonic acid; and if they went low enough in the furnace the whole of the iron which had been reduced in the top would pass again into oxide of iron. So that, suppose he added on to the original 57,000 another 20,000, he had 77,000 of heat of which he could avail himself. But in what manner would they avail themselves of it? If they were going to make iron with less coke it meant they were putting on more ironstone. As soon as they put on more ironstone it at once disturbed the relation which existed, and had existed, between the carbonic acid and carbonic oxide—for, as every ton of iron gave 8·14 of oxide, if they doubled the quantity of ironstone it gave 16·28 of oxygen, and with the temperature they would have under these circumstances they would undo their work. He did not believe it would happen to a manager of a furnace, for as soon as he attempted to load the furnace no doubt the cinder would begin to change, and instead of pursuing to its legitimate end the loading of the furnace the increase of burden would be discontinued. And what would happen? Why exactly what had happened in a large furnace at Ormsby. There they had a large furnace with blast heat and a temperature of 1436°, and all the extra heat conferred upon the blast, after doing precisely the same amount of work as the coke at the Clarence Works, with the same amount of coke, was going out at the top of the furnace. In fact, in attempting to alter the condition of the gases in a blast-furnace they would be met with the difficulty to which he had alluded—viz., if they attempted to influence the amount of carbonic acid beyond what he believed was a maximum amount in blast-furnaces, it would be found that the reverse action made would re-oxidise the iron ore which had been reduced. With respect to Mr. Whitwell's stove, it had produced the effect which that gentleman had desired; but, in point of fact, Mr. Whitwell had merely enabled a small furnace to do the work of a large one. He was of opinion that, under ordinary circumstances, was a change which in practice would scarcely be found to answer—for all the small ways of economising heat once obtained there could be none more simple and less costly than to allow the superabundant matter of material about it to be heated to catch the heat about to be lost. If they introduced a blast at this high temperature it would simply be blowing at the bottom, and catching it at the top. (Cheers.)

Mr. WILLIAMS asked Mr. Bell to state what, in his opinion, was the highest temperature of blast which would be beneficial? He also added that he was sure the able manner in which Mr. Bell had treated the subject would excite the admiration of every one. (Cheers.)

The CHAIRMAN said that in page 90 he had summarised the factors which served as the basis of his calculations for the two furnaces. The coke used at one was 22·75, and at the other 18·00; the temperature of the blast at one was 850° Fahr., and at the other 1324° Fahr.; the temperature of escaping gases at one was 892° Fahr., and at the other 478° Fahr. Although those factors were so dissimilar in character, yet when he applied them to ascertain really the number of units which had been absorbed in the process, they might start with the reasonable assumption that they gave something near the actual amount of heat involved in the manufacture of a ton of iron. The conditions were not precisely similar; at Consett they were using a richer ironstone—instead of using one of 41 per cent., they used one of 48 per cent. But as there would be half a ton less stuff to melt, and a less quantity of carbonic acid to extract from the limestone, in consequence of using a greater quantity of flux, he had made out the difference to be about 9000 units; and if that were the case it would require 71,000. Proceeding with these factors so dissimilar in character the first furnace, which had that moderate hot blast, really absorbed 62,176; and, therefore, he thought he was entitled to claim that as being very near to what he had set down. In the case of the other furnace heated with 1324 blast, the number of units was 62,167. In addition, he thought it right to state that he estimated synthetically the composition of the gases by considering what had gone to build them up. There were no two furnaces which corresponded more closely with what they should have done, looking at the quantity of coke and air used in the formation. With respect to the second question, he thought the table which he had given would very nearly answer the question—the blast ought to be taken in something like 12,000, to give 46,000 units.

Mr. COCKERELL said he could not exactly understand the Chairman's reasoning on the subject of the gases escaping from the top of the furnace. For his own part he thought that units of heat were valuable for certain purposes; and he thought that if the gases were passed through an additional amount of ironstone that ironstone would be melted by a lower heat, and that unit of heat absorbed must be good from deduction. The question was a matter of experiment and calculation as to when that action ceased.

The CHAIRMAN: If you are correct it is no more a matter of experiment.

Mr. SIEMENS, F.R.S., said that with respect to the question he might put it in this way—if Mr. Cockerell found that the gases escaped at the top, and then sent them in a load of ore, no doubt he would absorb the heat, and after he had raised this additional amount of ore he would be able to continue that process. If he wanted to work the furnace in a continuous manner, he must dispose of the 700, but if he wanted to make an experiment he might put a great load on, and say "I have got it." (Hear, hear.) With regard to that part of the Chairman's paper which he took the liberty of differing from on the last occasion, he was still a dissentient. He still held that an increase of temperature in the blast would produce a beneficial result very much in proportion to the increase of temperature. He thought the chief point of difference was on that occasion that the Chairman took 1 lb. of ore, and referred his results to unity and quantity of ore, but he (Mr. Siemens) referred it to the unity and quantity of blast. He thought this latter plan was the best; if he could show for every degree and every unit of heat added to the blast they produced equal saving of coke in the blast furnace, then he considered it was a proof that an increase of temperature benefited them to an indefinite extent. The benefit went on in an increasing ratio. He thought this might be shown from the facts which the Chairman had brought forward in so complete a manner. The experiments admitted that the higher the temperature of the blast the lower the temperature of the gas when issued from the top of the furnace; therefore, it was not a qdestion of a uniform bank of heat which could be drawn upon, and no more, but the bank of heat had increased as they arrived at the lower temperature in the issuing gases. That was not all; the higher the temperature of the gases the greater the quantity of carbonic acid escaping from the furnace. It was not necessary to show the great advantage which would arise therefrom, as every pound of fuel turned into carbonic acid yielded three times the number of heat units to the ore than if passed as carbonic oxide. He was not ready to admit that the higher temperature of blast produced a higher temperature in the blast furnace. He believed the temperature in the blast furnace would be the same whether a higher or lower temperature of blast was employed. The reason he came to that conclusion was this—if a blast of a high temperature was employed, the oxygen was readily converted into carbonic oxide, whereas with a lower temperature there would be a proportion of carbonic acid. The carbonic oxide pure would not represent such an amount of heat as would be represented by the admixture. The temperature in both cases would not probably be the same. This condition would not alter the working of the furnace, but the result of the lower temperature would make itself felt in the upper portion, where we know, from actual results, that finally a larger proportion of carbonic acid gas is obtained. If those circumstances were taken into account they would not be at a loss to account for the beneficial result of increased temperature of blast. (Cheers.)

Mr. WM. WHITWELL said that from his own experience he could state that at Cleveland a great saving had been effected by the use of his stoves. He believed it yet remained to be proved what would be the effect of regular heats at additional temperature in blast furnaces in the northern districts. At any rate, he had proved by demonstration, and by experiments at Consett, which had been conducted over a period of eight months, that the saving effected by additional temperature was something enormous.

Mr. CONIFER said he had found that in practice people had reduced the quantity of coke by increasing the temperature of the blast. He asked what temperature of blast the Chairman considered should be the limit?

Mr. GILKS enquired whether, in the figures which he had given, the Chairman had allowed for the extra draught on the furnace, and the disturbing action which would it exercise?

Mr. B. SAMUELSON said that the experiments which the Chairman had made were of the highest interest, and it now remained for the members to verify those experiments for themselves. It was possible that the results were correct, but there might be some little hitch which might affect them. There was no doubt that the question was of the utmost importance and interest to the manufacturers of iron, and he had no doubt the members would try the experiment for themselves.

Mr. THOS. WHITWELL briefly referred to one or two of the points which had been raised, and repeated his conviction that an increase of heat tended to economise the cost. He also added that in the northern district cast-iron stoves had been found to be very perishable, and were liable to be burned down through the carelessness of the men employed.

The CHAIRMAN briefly replied to the observations. He said he agreed with Mr. Siemens to this extent, and believed that a hot-blast furnace was not better than a cold-blast, and for the simple reason given, that the extra heat thrown in by the blast was absorbed by giving it additional work to do. In spite of that, however, he could not take the same view which Mr. Siemens did. Supposing a particular point in the furnace had not altered its conditions at all; the very fact of having added an additional quantity of ironstone disturbed the conditions between the carbonic oxide and the carbonic acid, and wherever that point might be the conditions of the gases would be no longer the same. Gentlemen talked of experiments, but it must be borne in mind that it was not merely a matter of experiment, for the story told by blast furnaces, over and over again, was that after the first enlargement of 6000 feet but little benefit had been obtained. If there was any reason why carbonic acid should assume a different relation to carbonic oxide, why has it not done so? Referring to Mr. Whitwell, he went on to say that he would be the last to say anything depreciatory of any man's invention; but they were met there to pronounce what they believed to be the truth, and it was a mockery to come there and talk to each other in any other way than that of truth and common sense, and he was sure he would not be misunderstood if he arrived at a conclusion different to that arrived at by some of the gentlemen present. (Cheers.) He did not deny that Mr. Whitwell had saved considerably by the increase in the heat, but the question was—Where was the confine? Mr. Whitwell might save

coke in a furnace of 60 ft., but they were talking now about furnaces of 80 ft., and he maintained that when they had arrived at the point of converting the gases into a relative state, all beyond was lost. Of course, this was a strong opinion to hold, but he asked them all to make the experiment, and he was willing to abide by the issue. (Cheers.) He had always advocated a higher hot blast, and had spent thousands in persevering to obtain it; the limit had been increased, but was there no limit beyond what was not advisable to go? Was there not a limit imposed by nature? He believed there was. (Cheers.) He had confined himself simply to the physical aspect of the question, and if it were proved that he was wrong, of course he must submit.

At the last meeting Mr. JAMES PALMER BUDD read a paper entitled "On a New Process for Removing Silicon from Iron," and a brief discussion now took place upon it.

Mr. BUDD said he was sorry Mr. Wood had left the room, for that gentleman had made a trial of the process, and the results were favourable, and showed an improvement in the yield. Mr. Wood had also manufactured some xcellent flanges, for which he had before to buy metal at Westbury.

The CHAIRMAN said that, in regard to the process improving the quality or yield of the iron, he dissented *in toto* from a great many of the inferences which Mr. Budd had drawn. It was a mistake to suppose that silicon had anything to do with the melting power of pig-iron, for there were different varieties of iron where perfect fusibility could be obtained without any silicon at all. Mr. Budd also seemed at a loss to account for the fact that white pig contained almost as much, and in fact more, carbon after the process than before, and also more phosphorus. Now, if there was one thing more certain than another it was this—the utter inability of anybody to make carbon or phosphorus which did not exist before. The explanation of Mr. Budd's difficulty was that he had altered neither the carbon or the phosphorus, but had very materially altered the iron, and taken the iron and left the carbon; and instead of working, as Mr. Budd supposed he did, without waste, the fact was that the waste had increased by the increase of the phrosphorus and carbon.

Mr. BUDD said that, in coming to the conclusion which he had done, his chemistry was *a posteriori* and not *a priori*. He had refined 9970 tons by this process, and in the six months he found there was a saving of 1 cwt. 5 lbs. in the yield. In fact, the result he had arrived at was this—there was a process with nitrate which cost something, for nitrate was 1½d. per lb., but he had sought for something which cost nothing—some oxygenising substance. The substance which he had found to answer this purpose was hydrated hematite, containing about 12 per cent. of water, and a certain proportionate amount of peroxide of iron. What he did was to convert the commonest pig-iron into metal, and he did it at the rate of 300 or 400 tons per week; and he had an analysis showing that the metal was more pure than when refined by any other process, and there was no waste. He took a practical, not a scientific, view of the subject, and showed the actual results. (Cheers.)

On the motion of the CHAIRMAN, a cordial vote of thanks was then passed to Mr. Budd for his paper. A vote of thanks was also passed to the Privy Council for granting the use of the room.

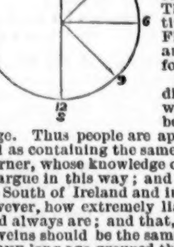
A cordial vote of thanks was passed to the Chairman for the able and courteous manner in which he had presided, and the proceedings, which had extended over nearly four hours, were brought to a conclusion.

The Royal School of Mines, Jermyn Street.

MR. WARINGTON SMYTH'S LECTURES.

[FROM NOTES BY OUR OWN REPORTER.]

LECTURE VIII.—In yesterday's lecture (said Mr. SMYTH) was described a few facts connected in a greater or less degree with the grouping of lodes in a variety of mining districts, it being observable that there is a considerable difference both as to the physical character and as to the materials of which the veins are composed, and that that difference is connected in a marked manner with their bearing across country. Considering the subject of grouping still further, we shall find that where the lodes are parallel, and at no great distance from each other, the miners have a strong belief that the portions which are most productive will be opposite to or over against each other, and *vice versa*. Hence the term "ore against ore." It is also found that when the veins are intersected by cross-courses, or crossed by flookans, they are expected to be more productive, or the contrary. This result probably occurs as often one way as the other; and so we often read in mining reports that the reason the lode is less productive is the interference of a cross-course, and in others that as a lode draws nearer to a cross-course improvement in its character may be expected. The real truth is that the cross-course has its own plane, and so has the lode, and the intersection may indifferently take place at either a richer or poorer point. It is, however, at these junctions of the right-running lodes of a district with these cross-courses that in many cases the more valuable portions of the deposits or veins are found. Thus in our own country ores of silver, cobalt, and nickel are found about these intersections. At the Carrington Mine a north and south lode was worked as a lead mine, but when it came into contact with the east and west vein the more valuable mineral of pyrargyrite or ruby silver was found, and so at the Fowey Consols, and at another mine, in the neighbourhood of Redruth, silver and arsenical ores of cobalt are found under similar circumstances, but are limited to the spaces between certain cross-courses. A remarkable case came under my own observation in which a very rich ore of nickel, being produced in an east and west lode, was limited entirely to the space between two cross-courses. One of the most noticeable instances on record, however, is that of the Wheal Ludcott, a mine east of Liskeard, where silver ore to the amount of thousands of pounds has been obtained from a space only a few yards in length and breadth, and not many feet in depth, at the intersection of a north and south vein with an east and west cross-course. The north and south lode had been worked for lead ore with a moderate amount of success, when it met with an east and west flookan, composed of soft argillaceous clay-slate, about 24 ft. in width, and then passed on again in a northern direction, and between the walls of the east and west cross-course, at the point where it met the north and south lode, there was for 10 or 12 fms. silver ore disseminated through the mass, while all around it nothing of the sort could be discovered. Cases of this kind are worthy of being remembered, because when they occur the imagination of owners at a distance become unduly heated, and they expect they are all at once possessors of the richest mine in England. Those, however, who are acquainted with phenomena of this kind will not allow their imaginations to run riot, and are very cautious indeed in hazarding conclusions until the ground is well opened before them. Equally remarkable results of intersection have occurred frequently in continental districts. The effects produced by veins running in the same direction on one another are also practically very important. Supposing veins run with a true parallelism, no great effects are observable, but if, as they descend into the crust of the earth, they run towards each other, a most decided effect will be produced, sometimes mechanically, and in most instances chemically. If two lodes unite in this way at a moderately oblique angle, they are apt when united to be considerably improved by coming together. It is, therefore, worth while wherever it can be done in beginning a mine to select for the shaft a place where intersections are likely to occur. At the gold mine at Zell, in the Tyrol, several lodes come together in this way, and are worked with profit, although the lodes separately are too poor. It is important to get true bearings of these in the depth, for if the ore should happen to dip away from you, you might sink your shaft where you will get no ore at all. When we are dealing with groups of veins in a district it is open to us to divide them by three different methods. Thus we may name them by what they produce, by the veinstone, or by their line of direction. In Saxony the lodes are divided into four different classes, according to their run. In England attempts have been made to group them with reference to age as well as direction. In Saxony, Sweden, Germany, and Norway the directions of lodes are described with reference to the clock dial, and our own coal miners adopt the same idea when they say the dip or rise is towards the two o'clock sun. There is no district in the world where the phenomena of lodes have been more carefully studied than that of Freiberg, in Saxony, where, in a distance of ten miles long by six miles broad, there are about 900 lodes, the characters of which have been made out with a considerable degree of certainty. These lodes have been classified for many years by their direction, some striking away to the north and north-east, and others running at almost right angles to them. Another series run north-west, but besides these there is only a small number of caunter veins. It is here that the divisional arrangement by the clock dial is most used. Thus dividing it (as in the diagram) from 12 to 3 represents the veins called Stehendegange; from 9 to 12, Flachegange; from 6 to 9, Spatgange; and from 3 to 6, Morgengange. The Stehende lodes contain quartz, along with galena, rich in silver ore. The Spat veins are composed of barytes in large quantities, alone or with ores of copper and silver. The Flache veins contain carbonate of lime, with barytes and silver ore. The Morgengange are not so rich for silver.



Divisions of this kind, however useful, in a given district are, however, likely to lead to generalisations which are not always accurate, and which will hardly be satisfactory to men possessing real geological knowledge. Thus people are apt to consider veins of the same period as to origin, and as containing the same class of minerals, if they run in the same direction. Werner, whose knowledge of veins was considerable, nevertheless was inclined to argue in this way; and in these days it is contended that certain veins in the South of Ireland and in England opposite them are the same. We know, however, how extremely liable to changes and interruptions deposits of this kind always are; and that, therefore, it is scarcely to be expected that groups of veins should be the same over so large an area. In Cornwall, Mr. JOSEPH CARNE long ago grouped the lodes there in this manner:—

1.—The oldest tin lodes running east and west, and dipping to the north.

2.—The same tin lodes, but dipping to the south. It has been much less easy of late years to define the difference between tin and copper lodes, because many of those mines which produced tin at first have been found to contain very valuable copper lodes; and at a great depth—say, from 200 to 300 fathoms—copper mines have become more valuable for tin than copper.

3.—East and west copper lodes.

4.—Caunter copper lodes, which carry their heads directly east, or from 30° to 45° to the south of east.

5.—Cross courses—that is to say, north and south lodes, which are more or less sparry.

6.—Newer lodes of lead and copper.

7.—Cross flookans running north and south, and containing clay only.

8.—Slides running east and west, which appear to be newer than all the others.

It may be asked in what way is it to be determined that one vein is older than another; and without going deeply into what is a very interesting subject, I may just indicate the facts upon which such decisions are arrived at. Sometimes one lode comes to another, and goes along with it, or both carry on their course as before, one cutting through the other. In the former case, if they come together at an oblique angle the veins are said to be contemporaneous, and the filling will be traced distinctly from one to the other. If the angle is small, and one is cut asunder by the other, or if we find one lode cut off at a certain point, and then heaved or thrown off to a greater or less distance—say, from a few inches to many feet or fathoms—the lode which cuts through the other is the newer. It is on that principle the relative age of the Cornish groups are determined. This is by no means an universal law, and an author named WALLACE has written an interesting work on the lead veins of Alston Moor, in which he brings forward good grounds for believing that in that district the reverse is the fact.

Heaves and throws, as they are called, furnish a series of facts which are fraught with a great deal of interest to the miner, not merely from the light they throw on the character of the veins themselves, and the mode in which they have been filled, but from the necessity which they sometimes involve of spending large sums in searching for the vein, which for the present may seem to be entirely cut off, and to which there may not be left the faintest trace or clue. This subject of the intersection of the lodes may boast of a whole literature of its own, and I need not dwell much upon it. If you turn to the work of Agricola, published 300 years ago, you will find that the miners then were frequently so puzzled by phenomena of this kind that their work sometimes was brought to a complete standstill. In those days they did not appear to comprehend that this solid foundation beneath our feet, which seems so immovable, is in reality a mass of matter which has been moved up and down in various directions. It is only by the different habits of thought now prevailing, which we owe to the study of geological phenomena, that we realise as a fact that nothing can be less stable than the crust of the earth, and that movements to a great extent have gone on, and indeed even now in a smaller degree are going on, in all directions. Amongst the other earlier German authors, ROSSEER treated upon this subject at great length, in a work entitled "Speculum Metallurgia," published in 1700, and pointed out several practical rules likely to lead to success in searching for a dislocated vein. VON OPPEL, towards the close of the last century, wrote on dislocation, and no doubt saw clearly that when the dislocating vein made an angle with that which was dislocated, the lost part was generally heaved towards the larger angle. Then after him came an excellent Hungarian writer named DELIUS, and WERNER, of Freiberg, who both produced very interesting works on this subject, but failed to get at the true facts of the case. About this time, however, there grew up a better appreciation of subterranean movements and displacements as the real origin of many of these puzzling phenomena. When we see striae running with a great amount of parallelism it is obvious that a slip must have taken place. In certain mines these striae are found on a much larger scale than in others. At Polberro there is a wonderful example, which no one can see without at once being convinced that there has been a removal of large masses of rock, and that a most severe friction has produced the striae. I happened myself to be in Flintshire when a large surface was laid bare, in which the striae were so bold that you might lay your arm in one of the hollows. If these rock masses have had both vertical and horizontal movements, that will account for striae in different directions, and show that the movements took place at different periods. After WERNER's time these matters began to be more understood, and a German officer, named SCHMIDT, in 1810, followed up by M. ZIMMERMAN, of the Hartz, very distinctly showed that in certain parts of the earth's crust, wherever there had been a vertical movement there had also been a horizontal one. That this is a true idea of what takes place has been proved in a singular manner. Certain marks were made in a cross-cut in the year 1726 on the wall showing the lines of working as they then existed. Soon afterwards the cross-cut was walled up, and not re-opened until a few years ago, when it was found that the marks were dislocated, showing that in that period there had been a movement in the rocks. Thus, taking SCHMIDT'S and ZIMMERMAN'S theory to be true, we have only to ascertain the amount of dip to obtain true data by which to seek for a lost lode. Mr. SMYTH then explained various ways in which this was done, and which may be thus summarised:—

When the two lodes dip contrariwise we must follow the side of the acute angle. When they dip within the right angle, then much depends on the depth of the dip, and we must follow the obtuse angle. When the dislocation has a less angular dip, then we must adopt special rules, which are only to be worked out according to each particular case. And the mode of working it out is a very simple one. When a lode is lost by the dislocation produced by a cross-course, lay down on a horizontal plane the course and direction of underlie of both the lode and cross-course, when there will be observable a smaller and a larger angle at the point of intersection, except in those rare cases where the one happens to be exactly at right angles to the other.

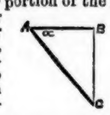
1.—Then, if the two veins (lode and cross-course) dip contrariwise—that is, if there is more than a right angle between their lines of dip as taken in *plan*—drive along the slide *on the side of the acute angle.*

2.—If they dip *together*, or within a right angle, when the dip of the lode is flatter than that of the cross-course, drive *on the side of the acute angle.*

3.—If the cross-course is flatter than the lode, adopt the following general rule, depending on the deviation of the dip of the former from the line of intersection of the two veins:—

General Rule.—At the point where the cross-course is touched determine and lay down horizontally the line of intersection of the two planes (lode and cross-course). Then from the same point project horizontally before you the line of dip of the cross-course, or, in other words, draw a perpendicular to it in front of you. Remark on which side of the line of intersection this perpendicular falls, and on that side cut in, and drive for the other portion of the lode.

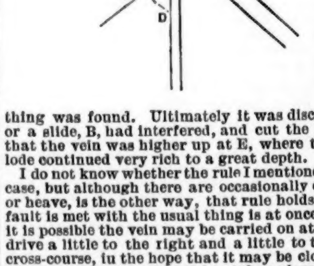
The line of intersection may be found either approximately by geometrical construction, or more accurately by the trigonometrical formula, where A B is the line representing the horizontal projection of the dip, from a point at A to another point, C, in the lode, at a vertical depth of h, below the level of A, the angle of inclination being α.



$$A B = \frac{h}{\tan. \alpha}$$

This is the only philosophical mode of treatment of which the subject is capable, and it is satisfactory, amidst so many elements of uncertainty, to have a rule which has proved, in most instances, to work out correctly.

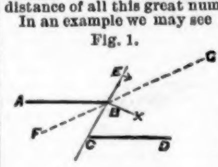
LECTURE IX.—In the last lecture I placed before you (said Mr. SMYTH) a few of the circumstances under which mineral veins meet with interruptions, and particularly by means of intersections, accompanied by dislocations of so serious a character as to disturb, either for a time or permanently, the continuation of the lode. In the greater part of the cases in which these intersections take place there is, as I have pointed out, to be found some kind of clue in the neighbourhood to indicate the direction in which the movement of the strata has taken place. Thus, in the workings of old mines in a district valuable indications may often be found as to such fundamental movements; and we shall be able to form a good conclusion by carefully noticing all such particulars thus laid bare. While, however, there are a great many cases to be judged by the mining agent by what he sees before him, he may, in going into a new country, find everything in a state of uncertainty, and requiring a great amount of observation and study as to how future operations are to be carried on. As an instance of how necessary it is in all such cases to make a thorough investigation of the ground, the phenomena may be mentioned which presented themselves at the Knockmahon, a productive copper mine in the South of Ireland. The strata there are much disturbed, and, indeed the interference of cross-courses, and consequent interruptions, are so numerous as to make the Knockmahon district extremely puzzling. At what is called the Stage Mine, in that district, a large and productive vein has been worked to a depth of many fathoms; but in its commencement a promising gossan was found at the surface, A. Its dip was accurately ascertained, and following the usual course, it was proposed to sink a shaft at some distance—say, 15 fms.—at C, to meet the vein at D, and by that means raise the mineral and the water to the surface. The shaft was accordingly sunk, and, to the surprise of all connected with the mine, no lode was found. What was to be done? Examinations and explorations lower down were made, thinking the vein might have become more perpendicular in its dip, but nothing was found. Ultimately it was discovered that a very small cross vein, or a slide, B, had interfered, and cut the lode in two, almost vertically, and that the vein was higher up at E, where the workings were resumed, and the lode continued very rich to a great depth.



I do not know whether the rule I mentioned in my last lecture was tried in this case, but although there are occasionally cases met with in which the throw, or heave, is the other way, that rule holds good in 19 cases out of 20. When a fault is met with the usual thing is at once to drive through the cross-course, as it is possible the vein may be carried on at the opposite side: but if not, then to drive a little to the right and a little to the left, on the opposite wall of the cross-course, in the hope that it may be close at hand. It frequently happens, however, that a movement has taken place which has thrown the vein fathoms away from the point at which it was lost, and in some cases years have passed in fruitless efforts to find a missing vein, and mines have been abandoned in despair. A valuable contributor to our knowledge on the subject of dislocations was Mr. Wm. Jory Henwood, of Penzance, whose work forms one of the volumes of the Cornwall Geological Society. He examined a great number of these intersections, and tabulated the results. Out of 733 intersections of lodes by cross veins he found 22·7 per cent. lodes intersected, but not heaved; and those which were heaved in the direction of the right hand were 51·1 per cent., and those heaved to the left hand 26·2 per cent. Thus you will readily understand how practical miners, having observed the preponderance of heaves to the right hand, say, when a lode is lost, that it is more likely to be found to the right than to the left hand. Again, he found that the heaves to the side of the larger angle were 62·5, while those to the side of the smaller angle were only 12·9, a disproportion so large that it is no wonder miners have a tendency to follow the side of the greater angle. Mr. Henwood also found that the mean distance of all this great number of dislocations was 16·4 feet.

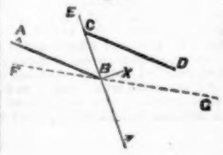
In an example we may see that the general rule proposed in the last lecture may assist us in showing how the heave may take place—First, on the side of the smaller angle, when the heave is to the right hand; *A B* being the lode, *E C* the cross-course, *F G* the line of intersection, *C D* the heaved continuation of the lode, *B X* a perpendicular cut across the cross-course at the point *B*, where the lode is lost. The arrows represent the direction of the underlay.

Fig. 1.



In the same way the line of intersection in Fig. 2 slightly varying from the different strike and underlay, though both of them remain mainly similar, the heave will be indicated by *B X* to be a left-hand heave on the side of the smaller angle.

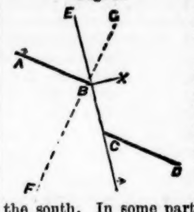
Fig. 2.



And in Fig. 3, with a further slight variation in the line of intersection of the two planes, a right-hand heave will be indicated on the side of the greater angle.

As I said before, it is important to test a view of this kind by a number of examples, because, although there may be a few exceptions here and there, we must not decide against a rule

Fig. 3.



which seems to prevail in the majority of cases, but regard that majority as of the highest importance in endeavouring to make out what has happened in these curious phenomena.

Amongst the exceptions to be found I may mention as one of the most curious what occurred, at a depth of nearly 300 fms. from surface, in the lower levels of the Fowey Consols Mine, by which two veins are worked, one called Trevethan's lode and the other Botterill's lode, which run parallel to each other until they meet with cross-courses, the result of which is that one is heaved to the right hand along the side of the greater angle, and the other to the left on the side of the smaller angle. The reason of this is that the dip of one lode is to the north and the other to the south. In some particular districts such cases occur very frequently, and in Mr. Henwood's paper there are many interesting details respecting them.

We must now consider another series of metallic depositaries—those of an irregular character, which are of vast importance, although there is nowhere any such accurate description of them as may be found of the stratified rocks. These irregular deposits are so extremely various that it will be convenient to separate them into four divisions, viz.—

1.—Those which follow, more or less, the contact of rocks of different classes and descriptions, and which, therefore, approximate in character to lodes. Instead, however, of passing, like lodes, from one rock to another, they are usually confined to the individual rock in which they are found.

2.—Those which are closely connected with, or imbedded in, the crystalline or aqueous rocks.

3.—Those associated with stratified or metamorphic rocks.

4.—Those which occur in the limestone formation.

These irregular deposits go by various names, depending a good deal upon the nature of the working, or given merely to distinguish them from the lodes. Thus, in France the term "amas" (and in Germany "lager") is commonly used when the mass approximates in form to a lode or bed. In Germany those depositaries of a more limited kind are called "Stocks," and according as they are vertical or horizontal "stahende," and "liegende."

1.—Taking, then, our first division, an example is furnished by the iron ores of the Hartz, which lie between the greenstone and limestone, putting on an appearance at the surface, more or less, of lodes, but they give out in depth, very differently to the ordinary regular lodes. In Germany tin is found disseminated through granite rocks, and called "stockwerke," because they are worked in stages, or stocks. A number of rich deposits of this kind are worked in Bohemia, and along the Saxon frontier, for tin. They are near the surface of the ground, where there is found a mass of granite, enclosed in beds of gneiss and clayslate. Within the granite are a great number of small veins, or strings, containing tin ore, associated with fluor-spar, wolfram, witherite, and other substances, so as to make it worth while to lift the whole mass. Similar irregular deposits have been worked in Transylvania (at Csetatzei, for example) centuries ago, and are still worked, for gold as well as tin, over a considerable extent of country.

2.—Irregular deposits occur in the crystalline rocks in vast masses (sometimes, when small, called pockets of ore), but are not imbedded. One of the most remarkable in Europe is that of the Monte Catini, upon which, for its extent and small number of men employed, is one of the most profitable mines in Europe, and has made continuous large profits for 30 years. It is, moreover, in a tertiary district, where we should not expect any rich mineral deposits, At the surface there cropped out a little band of soft serpentine, 1 ft. or 18 in. wide, and in this small specks of copper ore were observed. This led to its being worked in the middle ages, but it was not productive, and, therefore, not opened out to any great extent. At length some Englishmen took the mine in hand, and carried the works down to 90 fathoms, where they found stones of copper ore, evidently rounded, rubbed, and scored by attrition. The rock, which is locally called "gabbrossa," is of a very variable nature—in some parts distinctly stratified, and at others intruded, or ejected as it were, into the serpentine. Where the gabbrossa met the serpentine there occurs the rich ores for which the mines are famous—bornite, copper glance, sulphide of copper, without the slightest trace of impurity. The serpentine, which has the shape of an immense tongue, stretching out to an enormous width at the roots, is bounded by another harder substance, which bears no ore. This is a case of extreme interest to our miners, inasmuch as serpentine exists in this country, although as yet it has not been found here to have any such profitable mineral connections; but it is evident that these contact deposits may turn out to be extremely valuable, even although the appearance they put on at the surface is of an unpromising kind.

3.—Analogous deposits are also found in the stratified rocks; and of these nothing is more striking than the salt beds of Transylvania and of Wielieska, near Cracow. In the latter the excavations are of the vastest character. You may walk there into a large ballroom, 500 feet square, hollowed out of a single lump of rock, supporting on it masses, which at the sides rest on certain clays, or argillacious schist. Smaller chambers of this sort, although 100 feet high, are not uncommon. Another great mass of mingled sulphides of copper and other metals of great value is found at Rammelsberg, in the Hartz. It lies in stratified beds of the older grey-slate period, partly Silurian and partly Devonian—rocks of the greatest hardness, where vast masses go deep into the crust of the earth, and are worked many hundred feet below the surface. The deposit is about 1800 feet in length, about 400 feet in depth, and 150 feet in width from one wall to the other, forming one solid mass of various metallic sulphides, mixed with crystalline quartz and hornstone, and has been worked, probably, for 1000 years continuously. It contains gold in small quantities, silver, copper, zinc, lead, and a number of other metals. The copper ores of Fahlun, in Sweden, and those of Norway, are also famous as obtained from irregular deposits of great extent, richness, and value.

4.—The irregular deposits found in the limestone formation are of great value to us in Great Britain for iron ore, and are also extensive and important in Prussia, Belgium, and Spain for certain minerals. In England it is the carboniferous limestone, which overlies the coal measures, and which mostly obtains a great thickness in itself or in conjunction with shales and sandstones, which supplies vast quantities of iron for the manufactories of this country. The most important districts are those of Cumberland and North Lancashire. The iron ores of Cleator Moor, near Whitehaven, are productive of vast quantities of the most valuable hematite iron; and, taking the whole of the North of England, the amount obtained per annum from these irregular deposits reaches a million and a half tons. The formation is peculiar and varied. In many places it is like a vast dish, and the ore is very rich, then suddenly there is an end to it. It is as if a wide, irregular chasm had been created, and then filled with solid iron ore. In these irregular deposits, however, we must always be prepared for them to be cut off suddenly by a chasm, as it were, filled with valueless material. It is, therefore, found necessary to have exploratory work always well ahead, so as to prevent an entire stoppage when the deposits are thus cut off, and the works suddenly pulled up. In the Forest of Dean there are large masses of crystalline rock lying in the upper portion of the carboniferous limestones. They are called locally "creases," and are found up to the surface, or at a few feet only below it. The ore is often many fathoms in thickness, and occurs in all sorts of forms, but it is always between the top and bottom of the limestone, and when it is of a reddish argillaceous character. To take a deposit of this kind to be stratified ore, as it is stated to be in some books, is a gross error. In some places it puts on the appearance of a lode, but the cavities in which it is found appear really to have been originally large holes, or, as they are called, "churns" or "chains." Sometimes they are found in a solid and compact condition, and at others so loosely put together as to be easily brought down by a pick, or a stick, or even by throwing a stone at the face. In dealing with these deposits the most careful investigation is necessary, as without it the mining engineer may drive past one of these great deposits without touching it, instead of finding it and perhaps obtaining 10,000 tons from one place. In the lead mining districts of the North similar deposits of that mineral occur, and where they are called pipe veins or flots. These are often very curious, and sometimes, when at their greatest richness, will be entirely changed by an alteration of rock. Magnificent deposits of this kind are found in Belgium, Prussia, Westphalia, and the North of Spain. In the neighbourhood of the Asturias deposits of lead and zinc are associated with dolomitic limestone, which long ago was observed to be connected in some way with the presence of lead and other ores. There are other depositaries of this kind in the South of Europe, now producing large quantities of mineral, and likely to do so for many years to come.

SOCIETY OF ENGINEERS.—At the last meeting, on Monday (Mr. F. W. Bryant, President, in the chair), after the adjourned discussion on Mr. Charles J. Light's paper, "On the Need for Further Experiments on the Strength of Materials," a paper was read "On Apparatus for Measuring the Velocity of Ships," by Mr. V. Pendred, and the following candidates were balloted for and duly elected as *Members*: Mr. George Farren, C.E., Clynnog, Carnarvon, and Mr. Alfred Hope Wood, gas engineer, The Hollies, Hastings. As *Foreign Member*: Mr. George Thomas Light, Adelaide, South Australia; and as an *Associate*: Mr. Frederick Williams, Abingdon-street, Westminster.

BAD BOILER-MAKING.—At the Steam-Users' Association monthly meeting, at Manchester, Mr. Fletcher, the engineer, said that five explosions had occurred during the month—of one, which occurred at a tin works, he had been favoured with particulars from an engineer residing in the locality. The boiler was externally fired, and of plain cylindrical construction, the front end being flat and the back hemispherical. Its length, as nearly as may be, was 33 ft., and its diameter 6 ft., while the thickness of the plate was nine-sixteenths of an inch in the flat end and half an inch in the remainder of the shell, the pressure at which it was stated to be worked being about 20 lbs. on the square inch. The boiler was 17 years old, but the plate at the front end had only been put in about a year. The boiler gave way at the flat end, rending all round, or nearly so, at the root of the angle iron attaching it to the shell, when the main portion of the boiler was blown backwards and the front end forwards for a distance of about 40 yards. In addition to this, another boiler alongside was thrown from its seat, while fragments of piping and brickwork were scattered in every direction. The cause of this explosion will already be apparent from the description given of the form of the boiler and the mode in which it gave way. The danger of these flat-ended boilers, unless strengthened as in those of the Lancashire or Cornish type, with flue tubes running right through them from end to end, or else adequately stayed in other ways, has already been pointed out in previous reports, and the particulars given of a number of disastrous explosions that have occurred to such boilers from the neglect of these precautions. * * * It is in consequence of the number of cases of this sort that occur from time to time that the recommendation is so frequently given in the Association's reports—that every boiler should have its own non-return or feed back pressure valve, and that the feed inlet should not be below the level of the furnace crown, but slightly above it, so that in case of any re-flow the furnace crown would not be laid bare. This is certainly a most simple suggestion, and is recommended to every member as a wise precaution.

"The Public Telegraph Companies," with charts, published by Mr. W. L. Webb, of 8, Finch-lane, and Stock Exchange, London. This useful and handy little book has found such ready favour with the public that the publisher has found it necessary to issue a second edition, with a good deal of additional information. For convenience of reference everyone connected with telegraph companies should keep a copy by him.

London: Printed by RICHARD MIDDLETON, and published by HENRY ENGLISH (the proprietors), at their offices, 26, FLEET STREET, E.C., where all communications are requested to be addressed.—*Dec.* 11, 1869.